Testing of new shifting current electrodialytic treatment setup for efficient treatment of Cr-contaminated soil fines

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Testing of new shifting current electrodialytic treatment setup for efficient treatment of Cr-contaminated soil fines

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Cr contamination is regularly encountered in surface soil and poses a risk towards human health and the environment. Cr is particularly mobile and toxic in its oxidized form: Cr(VI). Previous investigations of the influence of Cr-speciation on electrokinetic remediation (EKR) in stationary setups showed that removal of Cr(III) occurred only under highly acidic conditions [1], and Cr (III) removal from industrially contaminated soils is slow compared to removal of other heavy metals [2]. It was shown that Cr(VI) is much faster remediated by EKR than Cr(III) [3]. Indeed, Cr(VI) was observed to be faster remediated than both Cd and and Ni under acidic conditions [1] and removal of Cr(VI) was observed to increase at neutral/alkaline conditions from spiked soil [1]. Reduction of Cr(VI) to Cr(III) during stationary EKR was documented [1]. In general, however, Cr was recovered in the anolyte when soils were spiked with Cr(VI) [1, 4, 5, 6] and in the catholyte when soils were spiked with Cr(III) [7, 8, 9]. When treating soil-fines in a suspended setup as reported in [10], as much as 53% Cr was, however, transferred to the catholyte as Cr(III) from a CCA-impregnation contaminated soil within 10 days. But Cr(III) remained the slowest contaminant to remove compared to both As, Cd, Cu, Ni, Pb and Zn; and from two other soils less than 20% Cr was removed by identical treatment [10]. Thus development proper enhancement method is needed to be able to remediate Cr(III)-contaminated soil efficiently.

In the present work, a new treatment concept is tested for its feasibility on Cr-remediation. In the new setup, soil fines are treated in suspension with alternating current between two anodes at different frequencies. One anode is placed in the anode-compartment and the other anode is placed directly into the middle compartment containing the soil fines suspension (figure 1) with the aim to oxidize Cr(III) to Cr(VI) by direct contact between electrode and contaminant.

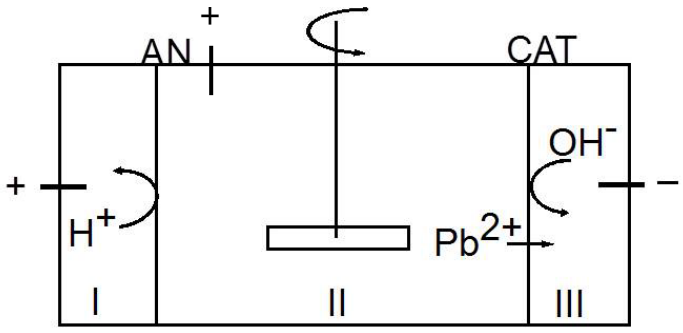

Figure 1. Experimental setup

All experiments were made with soil from the Collstrop-site in Hillerød, Denmark, contaminated by CCA-impregnation activity. Thus contaminated by Cu, Cr and As. Experiments were made according to the plan listed in table 1.

Table 1. List of experiments

Exp.	No of compartments (fig. 1)	Frequency of alternating current
2C	2 (only II and III)	0 (i.e. only anode in middle compartment on)
3C	3	0 (i.e. only anode in anode compartment on)
3C-min	3	Every minute
3C-hour	3	Every hour
3C-day	3	Every 24 hours

The results show that direct contact between the contaminated soil fines and the anode significantly enhances remediation efficiency of Cr.

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